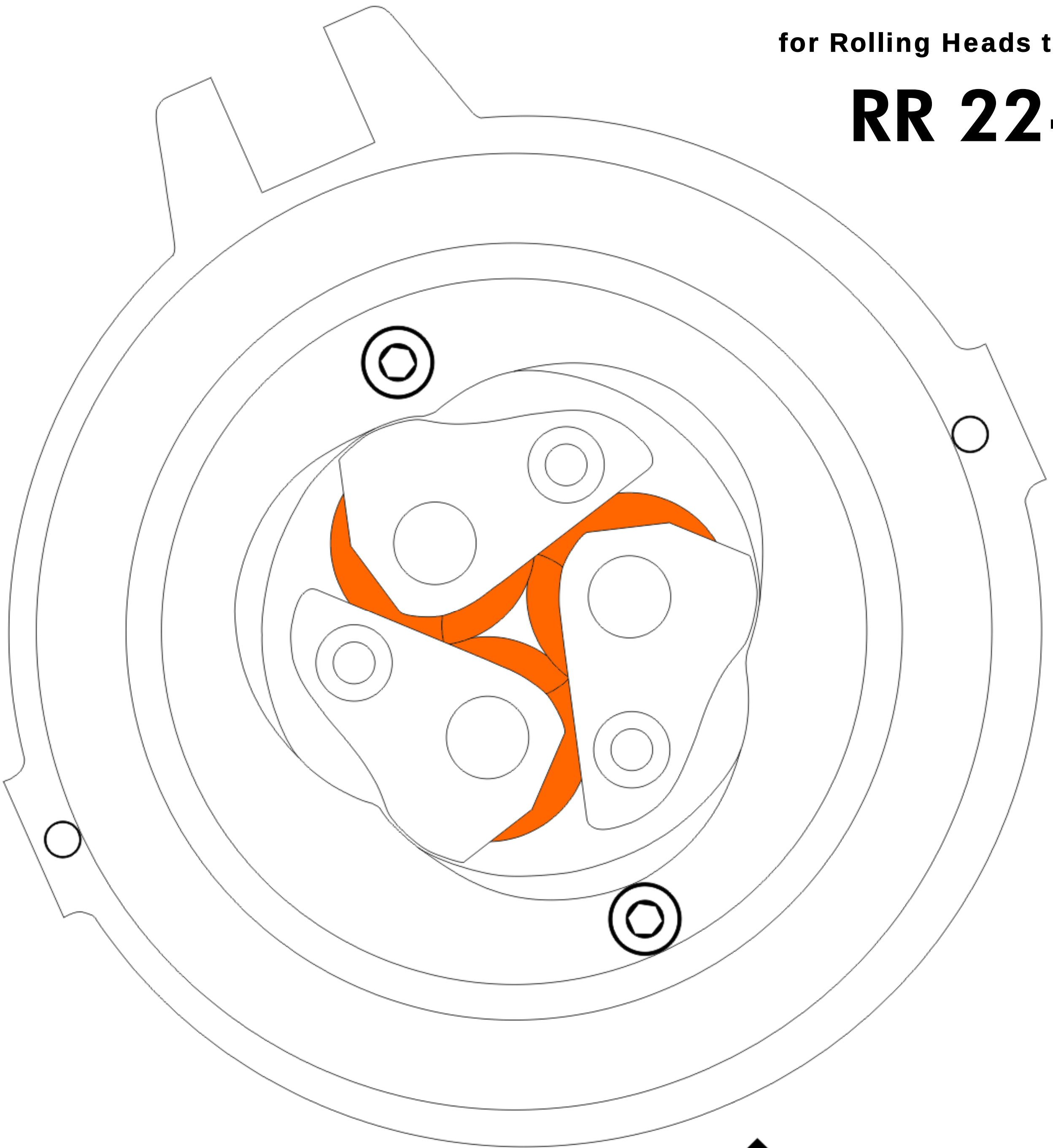
Operating Instructions

for Rolling Heads type:

RR 22-2



WAGNER®
WERKZEUGSYSTEME
MÜLLER GMBH

Instructions for rolling threads

		Page
1.	The material to be rolled must be suitable for cold working.	**15**
2.	Generally, the initial diameter should coincide with the effective diameter of the thread to be produced. Any increase to this dimension will present a risk of damage to the thread rolls.	**14 - 20**
3.	All parts must be chamfered prior to rolling. The recommended angle for vee threads is 15° (30° included) to a depth of between 0.016" and 0.032" (0.4 mm to 0.8 mm) below the minor diameter. For Acme threads the angle should be approximately 8° (16° incl.).	**18**
4.	When any alteration is made to the setting of the head, such as adjustment or the fitting of new dies, the next component produced should be carefully checked. It is frequently advisable to roll a test piece before proceeding with a large production run.	**13**
5.	The rolling speed must not be less than 100 feet per min. (30 m/min)	**18 – 22**
6.	The coolant should be a rich mixture of cutting oil and must be applied generously to the point of engagement between rolling dies and workpiece. During rolling, the component should become moderately warm at most. The coolant should be well filtered to avoid contamination from ships or abrasive particles.	**21**
7.	Threads must always be rolled in one pass. Due to the work hardening action, a second pass involves a risk of damage to the dies.	**22, 28**
8.	All rolls and holders are manufactured as sets and must only be used as such. To assist identification, each individual set is marked with a set number. For right hand threads, both holders and rolls should be placed in the head with their position numbers running clockwise in the correct order: 1 – 2 – 3. For left hand threads, special L. H. holders must be used but the same rolls are applied. The difference being that the position numbers of the rolls should then be placed anti-clockwise in the correct order.	**8, 8**
9.	Unless otherwise stated, WAGNER® thread rolls may be reversed in sets for longer life. The reverse marking A – B – C is then applicable, clockwise and in correct alphabetical sequence.	**10, 11**
10.	Clamp the workpiece concentrically. To start the rolling action, present the work to the head briefly but firmly. Swift and positive engagement should follow.	**29**
11.	Careful setting of stops will avoid collision damage and provide the desired thread run-out when threading up to a shoulder, flange etc.	**33**
12.	The thread rolling operation will not eliminate such defects as irregular material, lack of elongation properties, decarbonised areas in forged or rolled blanks or defective seams in welded tube.	**28**

See chapter 6: Consequences of improper setting and use of the threads. **25 - 33**

Table of Contents

The part numbers mentioned in the text are shown in the drawings of each rolling head on pages 39 to 40.
These part numbers should be indicated in orders for spare parts.
The dimensions of the rolling heads, the mounting dimensions as well as the opening and closing strokes and their directions are listed in the respective specifications contained in the thread rolling head brochure.

With the WAGNER® thread rolling head, you have acquired a heavy-duty tool workmanship and top grade materials (casehardened and ground steel) designed for use at very high operating speeds. Sturdy construction, ensure long and dependable operation.

However, where the rolling head is exposed to dirt, swarf or ships, the following safeguards should be provided:

- **efficient cleaning (filtering) of the coolant.**
- **suitable protection against dirt and chips.**
- **regular cleaning and servicing of the rolling head.**

This will ensure dependable operation and minimise wear.

1. Uses – operating range – advantages

Threads of different pitch and different diameter can be rolled in one head simply by changing the roll holders.
Equipped with three equi-spaced, idling profile rolls, the thread rolling head produces external threads in one pass by cold work.

WAGNER® thread rolling heads are suitable for rolling:
All cylindrical external threads such as vee-threads (to metric, British or US standards), Acme threads, round threads, wood screw threads as shown in the operating range specifications and tool list (holder table), using materials that are suitable for cold work and have been prepared as required. The regular tools are for single right-hand threads. Double threads and threads with higher pitches than indicated in the normal operating range specifications are only available as special versions upon request. Triple and multiple threads as well as square threads and threads having a flank angle of less than 10° cannot generally be rolled.
Left-hand threads with roll holders for left-hand threads. Sense of rotation of the part opposite to that for right-hand threads. Profile rolls and all other conditions as for right-hand threads.
Taper threads by means of tapered profile rolls, the maximum thread length being confined to the width of the profile roll. The normal taper is 1:16.
Tapered profile rolls can only be used on one side.
Special threads and profiles. Knurling and burnishing of shafts upon special request. Where a section to be threaded is situated between two diameters greater than the minor diameter of the required thread, this cannot be rolled. The part would not be capable of entering the closed rolling dies.
Thread tolerances. The tools indicated in the roll holder tables are sure to produce "medium" threads of or ISO – 6 g tolerance when making vee-threads. Where the blanks answer the requirements (premachining and suitable cold work characteristics of the material) the "fine" or ISO – 4 h thread tolerance can also be obtained.
In the event of special requirements, please submit details for quotation. As far as the accuracy of the thread pitch is concerned, it should be kept in mind that the

cold work behaviour of the material and the degree to which the thread is rolled play a major part. The normal thread rolling dies are intended for generally used engineering steel with normal threads for a nut height of 0.8 to 1 d. Specially corrected tools (see chapter 5.1.1 on page 15) are needed for rolling threads involving special requirements in regard of pitch accuracy and for materials with special cold work characteristics.

Thread rolling offers many advantages. Since the thread contour is formed by cold work, the grain structure remains unbroken, and the useful cross-section is not reduced by notching. The fatigue strength is improved. The resulting work hardening of the material improves the resistance to wear and corrosion. In this way, the surface hardness of the thread flank can be increased by 1½ to 2 times, depending upon the material involved. The surface of the rolled thread is burnished by the rolling operation so that the thread is less likely to become seized.

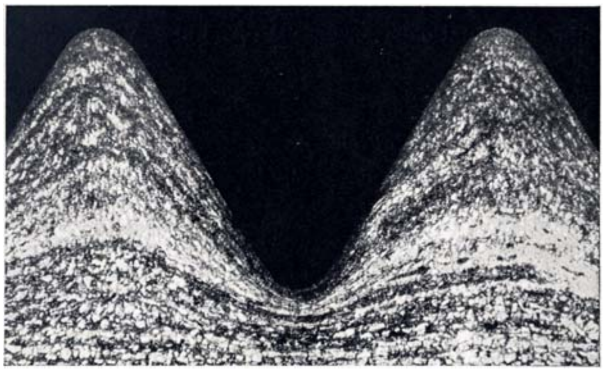


Fig. 1: Grain flow of a rolled thread

2. Changing the roll holders

To remove the roll holders, the scroll has to be pulled from the rolling head. For this purpose, remove the head cap screws [305] and twist the scroll until it can be pulled off clear of the roll holders. To twist the scroll, turn out the grub screws [301] in the scroll as far as required.

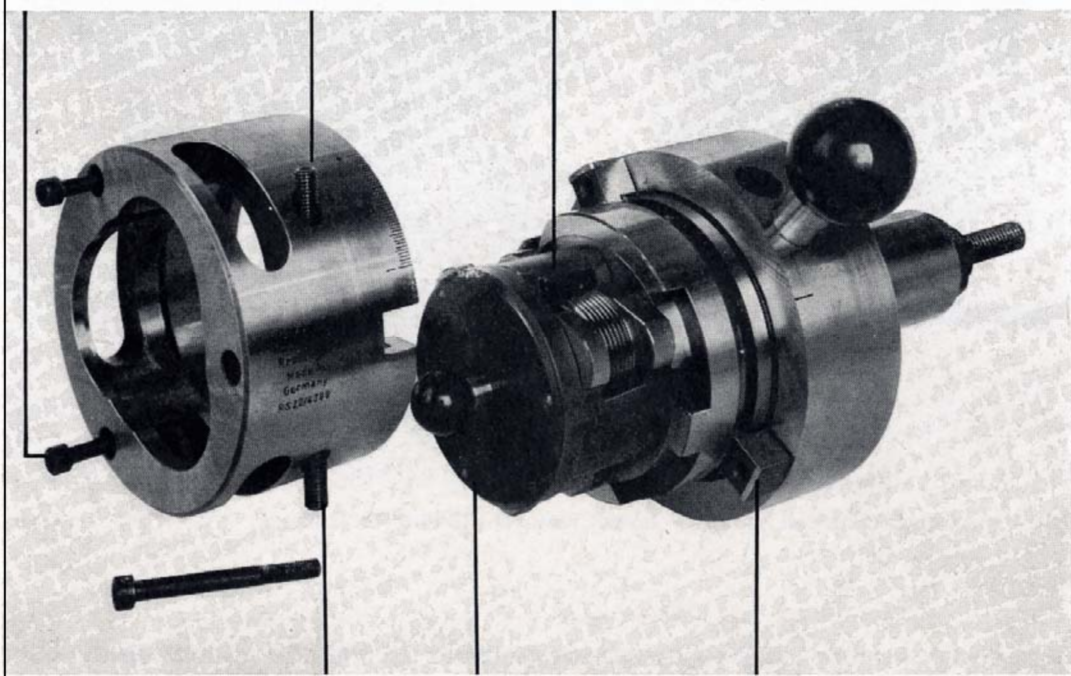


Fig. 2: Manipulating the head and changing roll holders

When dealing with the RS 22 and RR 22 heads, the roll holders are held together by a clamping disc [250] while pulling off the scroll. After the scroll has been removed and with the head in the open condition, swing out the roll holders until they are released from their bayonet mount and can be pulled out of the body.

2.1. Installing the roll holders

Introduce the holder stems into the holes in the body and swing the holders toward the centre so that the scroll can be slipped over the holders. When dealing with the RS 22 and RR 22 heads, attach the clamping disc [250] to the holders. For rolling right-hand threads, mount the roll holders in the order of 1, 2, 3 in clockwise direction and for left-hand threads in the order of 1, 2, 3 in anti-clock-wise direction.

Furthermore: Restore the scroll, adjust the diameter by means of the grub screws [301], and clamp by means of the head cap screws [305] in the insets [303]/[304]. Before mounting the parts, clean them well and apply molybdenum di-sulphide to the sliding surfaces. The thrust bushings [16] must be freely movable.

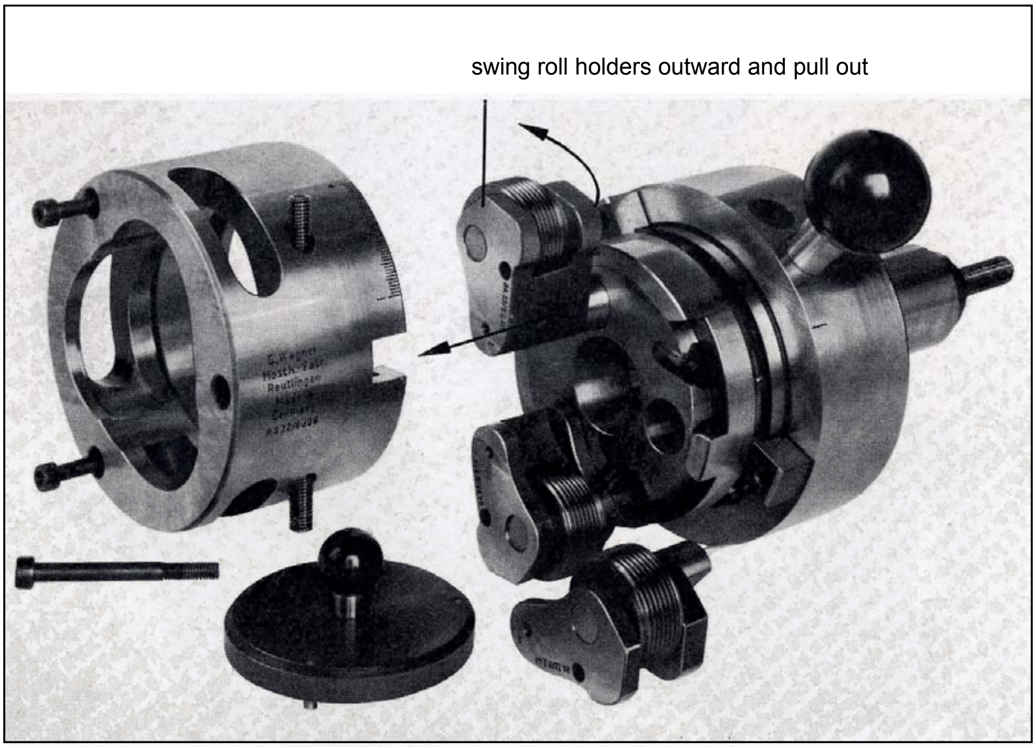


Fig. 3: Exchanging the roll holders - holder removal (RS and RR 22 heads)

2.2. Roll holder tables and roll holder coding

The roll holder tables indicate the threads that can be rolled with the various roll holder sizes as well as the associated size of the profile rolls. The profile rolls are

to be chosen in accordance with the thread pitch. The roll holder charts include only the most commonly used threads. Please consult us for unlisted types of threads and special threads within the diametral ranges of the individual roll holders. The roll holder tables can be found on page 43.

The roll holder designation is engraved into the front face of the roll holder, as for instance

RA 22   B   3.40

<u>This signifies:</u>

RA 22 = type of head

B = diametral range

3.40 = roll holder angle

Roll holders for left-hand threads are provided with the letter “L” following the letter for the diametral range such as “BL”.

The number of the roll holder, 1, 2 or 3, is found below the roll holder designation. Engraved in the back of the roll holder, behind the profile roll, is the set number of the roll holder, as for instance K 67 (see also Fig. 4).

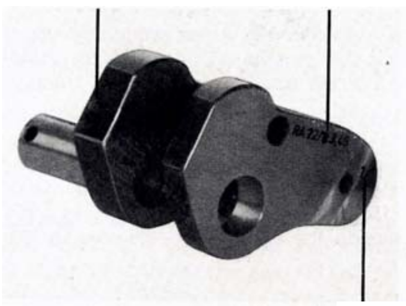


Fig. 4: Roll holder identification

It is important to keep in mind that roll holders can only be used in complete sets, i. e. both the roll holder designation and the set number must be identical.

3. Changing profile rolls

The rolls must be carefully cleaned before they are installed. Apply molybdenum di-sulphide to the hole (applying a thin coat of paste). Place the roll on a plaine surface and introduce a mounting pin having the same diameter as the roll journal pin and a length of slightly less than the width of the roll into the center of the roll hole. Fill the space around the mounting pin with the specified number of needles and bearing grease. (See also the drawings on pages 39 to 40 showing the individual components of the thread rolling head with mounting pins [50], [51], [52].)

Important note

Care must be taken to avoid the use of damaged needles. In the event of loss or damage to one needle only, the whole set must be discarded. Never replace one single needle, always a complete set.

During use, the needles are subject to considerable stress with a resulting decrease in diameter as they wear. To put a needle of normal size in with others that are worn would place such a strain upon it as to cause fracture and probably the destruction of the rolls.

Needles must always be replaced in complete sets consisting of the number specified in the tool list. Needles supplied by WAGNER® are manufactured to extremely close tolerances. Under no circumstances should commercial needles be used as they are outside the accuracy demanded by the thread rolling process. The mounting pin must turn freely in the bearing needles.

With the mounting pin in position, insert the profile roll into the roll holder. By pushing the journal pin through, from the back face (holder stem side), the mounting pin will be ejected and the journal pin will assume its correct position.

The roll numbers 1 – 2 – 3 or, with reversed rolls, the letters A – B – C must be in front and should agree with the holder numbers 1 – 2 – 3. To remove the profile rolls, it is advisable to press out the roll journal pin by means of the mounting pin. This facilitates the removal of the roll and prevents loss of the needles. In special cases, the bearing needles can be replaced by carbide bearing sleeves.

3.1. Profile roll coding

The faces of the profile rolls are coded as follows:

1. The number of the set: this consists of a figure, a letter, and an additional figure, for example **15 H 12.**
2. The roll number 1, 2 or 3 and, on the back, the letters A, B or C.
3. Details concerning the type of thread and pitch plus additional numbers and figures identifying some special feature.
4. Additional letters are a factory coding.

   The coding under items 1, 3 and 4 must agree for the rolls within one set.

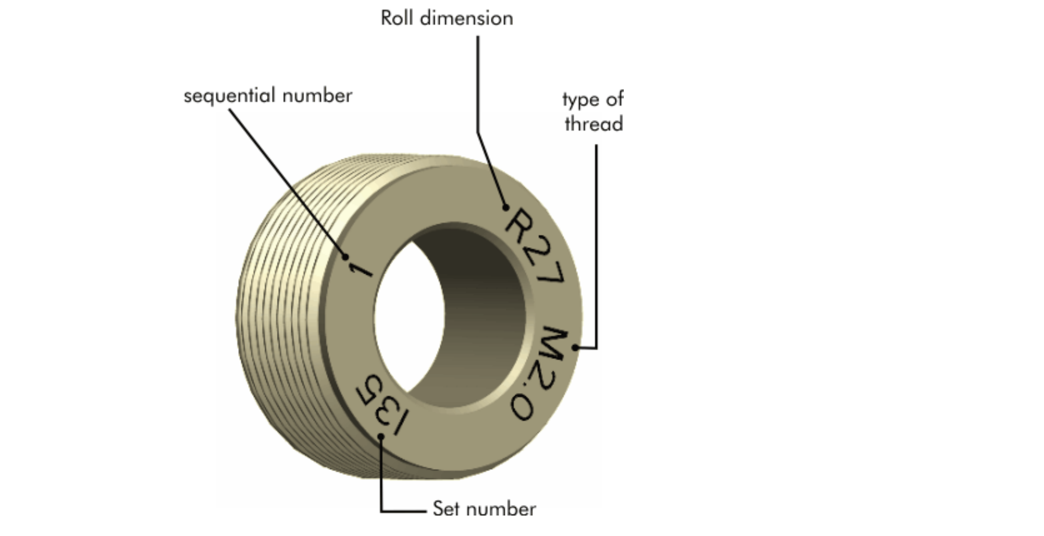


Fig. 5: Thread roll identification

Reference Item 3: Examples for the identification of the type and thread and thread pitch:

Coding - M 2.0 St Z:

Thread roll for all metric threads to DIN 13 (M) with a pitch of 2.0 mm (2.0 St) with correction (Z).

Coding - M 2.0 P Z:

Thread roll for all metric threads to DIN 13 (M) with a pitch of 2.0 mm according to ISO profile (2.0 P) with correction (Z).

Coding - W 14 GG Z:

Thread roll for all Whitworth threads with 55° flank angle to DIN 11, BSW aid BSF as well as for Whitworth pipe threads to DIN 259 (W) with a pitch of 14 threads per inch (14 GG) with correction (Z).

Coding - UN 14 GG Z:

Thread roll for all UN threads (UNC, NC, UNF, UNEF, NEF) to ASA Standards (UN) with a pitch of 14 threads per inch (14 GG) with correction (Z).

Thread rolls for taper threads have an additional identification of the taper as for instance:

Coding - W 1 GGZK 1:16:

Thread roll for Whitworth pipe threads with a pitch of 14 threads per inch and a taper of 1 :16, with correction (Z).

Other types of threads contain the respective identification in their coding such as
Tr = trapezoidal or standard Acme screw threads,
H = wood threads, etc.

Other letters or figures following the pitch signify special features of the thread roll as. For example, those required for correcting some special behavior of the material or deviations from the normal thread profile etc.

4. Adjusting the diameter

Adjustment of the thread rolling head for the thread diameter is preferably accomplished by means of a sample thread.

In such case, the closed head is adjusted by means of the grub screw [301] towards the sample thread until the latter can no longer be turned. For this purpose, the scroll has to be loosened by turning out the three head cap screws [305].
Begin with tightening the grub screw reducing the diameter - left-hand grub screw in the RS 22 and RR 22 heads when looking upon the front face of the head - and turning out the opposite grub screw. Once the correct position has been found, turn back the reducing grub screw a little to facilitate the removal of the sample thread.

The division on the scroll permits marking the position thus found for the scroll to be restored to this position for movement against the right-hand grub screw.

After the three head cap screws [305] have been tightened again, a trial thread can be rolled. Depending on the results, readjust the head by means of the grub screw [301] after the head cap screws have been loosened. If no sample thread is available, an arbor or pin can be used whose diameter is equal to the minor diameter of the thread to be rolled. However, this method involves greater risks of maladjustments and deviations.

The adjustment of the thread length varies with the type of head.

5. Rolling the threads

5.1. Operating procedure and condition of the blank

The flow of material caused by the thread rolling operation by cold work (the volume of material displaced by the rolling dies from the peaks of the thread profile towards the core of the threaded part must equal the volume flowing into the peaks) calls for an initial or pre-machined diameter that is about equal to the effecfive diameter of the thread.

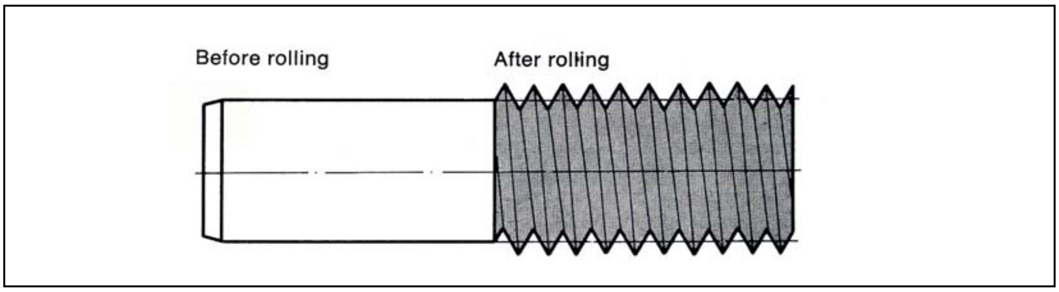


Fig. 6: Initial diameter for thread rolling

In the majority of cases, when dealing with vee-threads, this diameter is at the lower limit of the "fine" tolerance of the pitch diameter. But it can also be slightly bigger than the effective diameter, especially where the material is allowed to flow freely in longitudinal direction.

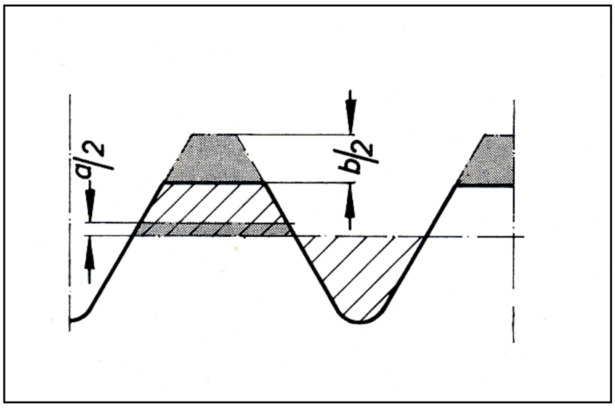


Fig. 7: Profile displacement during the thread rolling operation.

The difference a/2 at the initial diameter results in b/2 at the thread diameter.

Changes in the initial diameter are multiplied in the major diameter of the rolled thread by a factor of about 2 to 5. A change of 0.01" in the initial diameter can thus provoke a change of 0.05" in the major diameter of the thread (see page 17). This, practically, indicates the tolerance with which the previously found initial diameter has to be maintained.

5.1.1. Cold work characteristics of the material

Generally speaking, all materials capable of being machined by cold work such as pressing, upsetting, etc. and of withstanding the stresses of cold work without destruction are also suitable for thread rolling. A yardstick for determining the possibility of the thread rolling is the elongation and the strength or hardness of the material, i.e. its resistance to the penetration of the rolling dies. Normal thread rolls permit the economical rolling of threads into materials having a strength of up to about 76 long tons square inch at an elongation of at least 10 to 12% for vee-threads and of at least 12% for Acme standard screw threads and similar threads. Special thread rolls make it possible to roll materials up to a strength of 95 to 107 tons per square inch at an elongation of as little as 7% economically. High alloy materials of high elongation and low yield point but marked by a high degree of work hardening are likely to restrict the use of the thread rolling method.

The following steels are suitable for thread rolling: mild steels, alloyed and non-alloyed engineering steels, high-alloy, high-temperature and stainless steels, tool steels and high-speed steels that are not heat-treated.

Free cutting steels with over 15% sulphur or containing lead tend to spring surface cracks under heavy cold work stresses and should, therefore, only be used for rolling vee-threads when containing high amounts of sulphur. As far as non-ferrous metals are concerned, MS 58 (hard drawn free cutting brass) is rarely suitable for thread rolling purposes. Some alloys of aluminum, malleable cast iron and plastics cannot be rolled in all instances. Grey cast iron and most injection castings, likewise, are not suitable for thread rolling.

5.1.2. *Preparing the blank*

<u>Determining the initial diameter:</u>

As stated in paragraph 5.1, the initial diameter for rolling vee-threads into normal engineering steels is somewhat below the effective diameter. The exact initial diameter can only be determined by tests because of the widely differing extension and flow characteristics.

One method is as follows:

In the "p" diagram for M 2.6 to M 52 on the opposite page, a measure of "p" is indicated for the individual thread pitches as a factor by which the effective diameter has to be kept smaller. With such an initial diameter a "Medium" quality thread at the lower limit of the effective diameter would be obtained, with the major diameter almost being over-rolled. To prevent overload of the thread rolls, it is advisable to open the head a little bit. If the effective diameter is near the upper limit, the initial diameter must be somewhat reduced.

If the thread is not rolled up into the crest, the size "p", i. e. the initial diameter can be chosen a little greater.

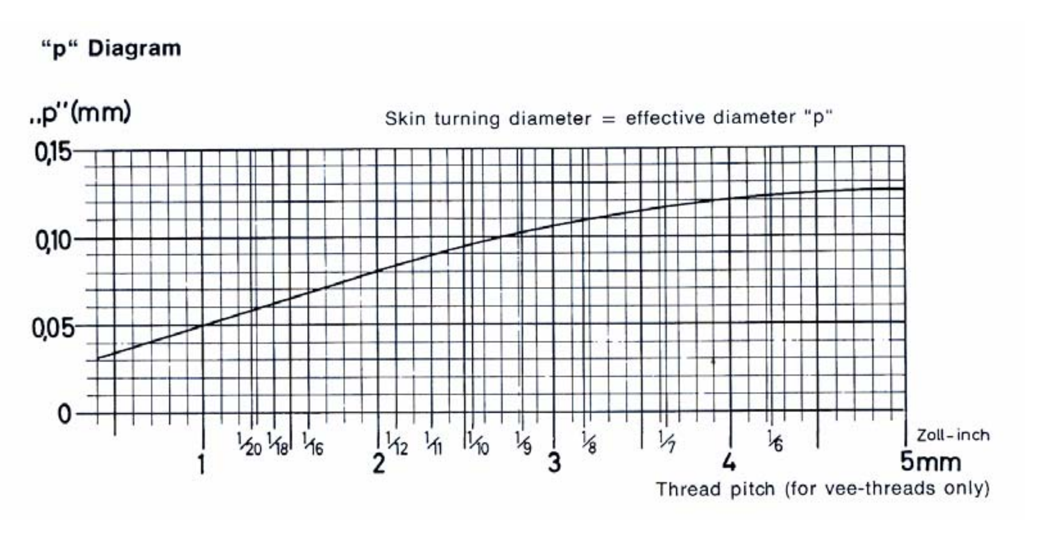


Table 1: Determining the initial diameter

Important Note

With the same head adjustment, any change in the initial diameter is multiplied in the major diameter of the thread by a factor of from 2 to 5. The higher figure has to be expected where the thread profile is rolled close to the crest. If the effective diameter of the thread is to be maintained close to the upper tolerance limit, the diametral adjustment of the head has to opened accordingly. In doing so, the tolerance of the initial diameter has to be held within accordingly closer limits. The initial diameter has to be chosen with a negative tolerance.

When dealing with threads requiring a high degree of "deformation" such as Acme thread or with materials of high extension, e.g. 50%, or when rolling pipes of insufficient wall thickness, not all the material is displaced into the thread crest so that the major diameter remains too small. In such case, the initial diameter must be bigger than the effective diameter of the thread.

To prevent overloads on the rolls when rolling Acme threads it is also advisable not to roll over the major diameter but to roll only lightly over the corners. This does not affect the strength of the thread.

The effect of oversize or undersize initial diameters:

the initial diameter of the blank is too great and the rolling head is correctly set for the thread pitch diameter, too much material is displaced into the thread crest so that a heavy pressure on the thread rolls and the needle bearing results. These parts will be destroyed if greatly oversized blanks are used. Since the volume of the material displaced is not changed, the excess of material is pressed towards the thread core; depending upon the size of the thread core, this can affect the pitch of the rolled thread or can cause the rolls to break under the excessive load.

If the initial diameter of the blank is too small while the rolling head is correctly set for the thread effective diameter, too little material will be displaced towards the major diameter so that too small a major diameter results.

Try to obtain an initial diameter with such a tolerance that the profile of the thread produced is **just slightly rolled in the corners** of the thread peak while the major diameter itself is not rolled or is only just touched by the rolls (a minimum unrolled

area must still be visible) so that the non-rolling of the major diameter remains under control.

5.1.3. Chamfering the part

The front end of the blank must be chamfered to permit easy axial movement of the blank between the rolling dies, using a diameter somewhat below the minor diameter of the thread (0.016" to 0.032" / 0.4 to 0.8 mm depending on the thread pitch). The chamfer should have an angle of about 15° relative to the axis of the part where vee-threads are concerned or of 8 to 10° for Acme and similar threads.

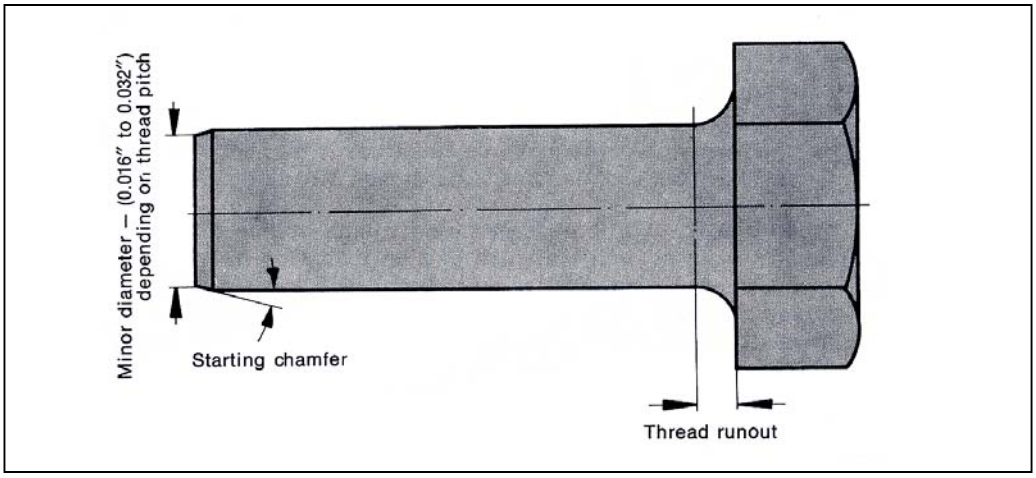


Fig. 8: Chamfer and thread runout

5.2. Machine requirements

Apart from such residual features as alloy, structure, strength, hardness and elongation, the rolling speed is of major importance. It has great bearing upon the life of the rolls and the quality of the thread produced. The minimum rolling speed (pheripheral speed of the work) is 100 feet per minute. Therefore, the machine must be capable of providing the required speeds and the necessary power to keep them constant under operating conditions.

For starting the thread, a manually or automatically operated feed unit must be available. The workpiece and rolling head must be positively attached in a con-centric position. Complete rigidity is essential to absorb both the initial engage-

ment force an the subsequent rolling torque. See paragraph 5.2.1 below for the required power. When using machines with several stations, care should be taken to ensure that chips or swarf do not enter the rolling head.

5.2.1. Rolling speed and required power

Suitable rolling speeds are:

for vee-threads:	free-cutting steel	200 to 330 fpm
	engineering steel	160 to 260 fpm
	alloyed, stainless steels	130 to 230 fpm
	tool steels, high-speed steels	130 to 230 fpm
	aluminum alloys, copper, brass (no MS 58)	160 to 330 fpm
for Acme threads, round threads, wood threads:	regular engineering steel	130 to 230 fpm
	high-alloy steel	130 to 160 fpm

Use the lower speeds for materials of higher strength and smaller pitches.
Besides the thread dimensions, the rolling speed and the material, the required power is also dependent on the degree to which the thread is to be rolled.

The following table shows approximate values that have to be corrected for the rolling used:

M 12 (½")	rolling speed 200 fpm	3½ H.P.	These approx. value apply to commercial engineering steels.
M 20 (¾")	rolling speed 200 fpm	4½ H.P.	
M 30 (1¼")	rolling speed 200 fpm	7 H.P.	
¾ - 6 Acme	rolling speed 160 fpm	9 H.P.	
1⅛ - 5 Acme	rolling speed 160 fpm	18 H.P.	

The nomogram "Calculating the rolling speed" on the next page indicates the speed required at any time.

Calculating the rolling speed

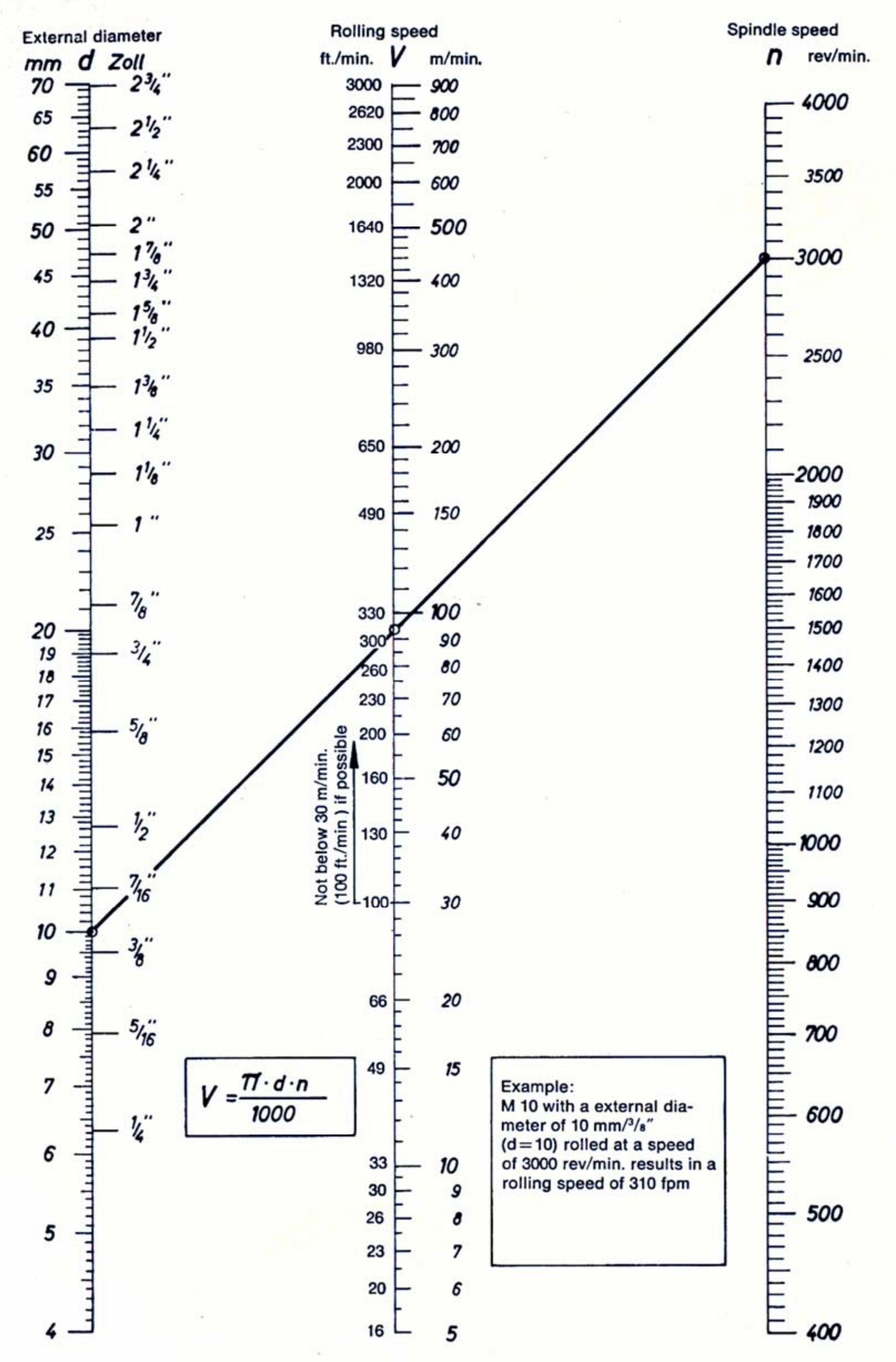


Fig. 9: Calculating the rolling speed

5.2.2. *Cooling the rolling head*

Positive and ample **cooling** of the rolling tools is imperative. The thread profile rolls are high-precision tools. To reduce wear and ensure long life and thus economical operation the user, in addition to assuring correct initial diameters, correct adjustment of the rolling dies on the part, and correct rolling speeds, should **provide satisfactory cooling to make sure that the parts are not allowed to get more than moderately warm.**

The jet of coolant should be directed to the point of engagement of the profile rolls with the part. **Filtering the coolant** is highly recommended to eliminate particles and chips that could get into the coolant either from the thread rolling operation or from other machining stations of the machine tool.

Particularly good results have been obtained using soluble oil emulsions, mixture rations varying 1:3 to 1:30. Thin cutting oils have also been found satisfactory when rolling materials that need more of a lubricant as opposed to a coolant action.

However, in the majority of thread rolling operations it is the coolant factor that is of greater importance. The use of high pressure additives such as Molykote etc., tend to extend the life of the rolling dies and to improve the quality of the thread produced.

The coolant chart on the preceding page contains a number of commercial coolants that have generally been found to be satisfactory. For special cases, the coolant manufacturer should be consulted. Information on more coolants is also available from the coolant manufacturer.

5.3. How to correct

Rolled threads cannot be corrected by a second rolling operation with readjusted rolling head as this involves a risk of destruction of the profile rolls.

The rolling head affords only the possibility of adjusting the diameter. If the thread pitch or the thread profile are to be changed, the rolling dies have to be changed.

Changing the roll holders

By selecting a roll holder with the next larger or next smaller holder angle (see roll holder table at the end of the booklet) the pitch can be corrected to a small degree both positively and negatively. It should, however, be kept in mind that any such correction involves added stresses for the profile rolls, especially when rolling material with marked surface hardening characteristics. There exists also a risk that a reeling error will occur in the pitch of the thread so that a thread of poorer quality is obtained.

Pitch correction in the profile rolls

The normal profile rolls for vee-threads are designed for a pitch accuracy that, subject to a properly machined blank, the pitch of the thread produced is sufficient for a nut height of 1 X d when using normal engineering steel, producing a thread of "medium" grade, and also permits to obtain "fine" grade threads. Special profile rolls with a special pitch correction have to be used for pitches which for some reason or other, such as a nut height of 3x d or special cold work behaviour of the material, have to satisfy other conditions. Heavy threads involving a great amount of material displacement such as Acme threads may require a higher degree of pitch correction than vee-threads. This will have to be determined by tests in the various cases.

5.4. Various adjustments and their effects

The roll holders and profile rolls incorporated in the rolling head only permit the adjustment of the thread diameter, i. e. the pitch diameter and, as a direct function

of this, the minor diameter are adjusted together. Depending on the initial diameter and the flow characteristics of the material, the major diameter of the thread is built up to the extent of even the crest of the thread being rolled (to be avoided) if the rolling head is adjusted close enough. If the head is to be adjusted close enough to reach the lower tolerance limit of the pitch diameter, the initial diameter has to be slightly reduced where the major diameter is being overrolled or rolled to a high degree.

See also paragraph 5.1.2 „Determining the initial diameter" on page 16.

5.5. Rolling die life in terms of production

If the necessary requirements are met, the profile rolls have a long useful life in rolling threads. Precise information cannot be given as variations are introduced by the varying operating conditions. The most important influences on the useful life of the rolls are listed below.

Material:

The better a material lends itself to cold work, the more parts will be produced. Materials of high strength yield less parts; the same applies to materials with a high degree of surface hardening during cold work. The surface condition, such as a drawing skin, especially in the case of chromium steels, is also likely to have a marked effect on the useful life of the profile rolls.

Rolling speed and cooling:

The rolling speed must be at least 100 fpm to avoid a noticeable reduction of the rolling die life. It should be chosen as high as possible, without however allowing the parts to become more than moderately warm. Use an ample and strong flow of coolant to keep the temperature at a minimum.

Machine tool:

The rolling head and part must be concentrically mounted and safely clamped. The power for starting the thread must be sufficient for any pitch.

Preparing the blank:

Generally, for vee threads, chamfering the leading end of the blank at an angle of about 15° to 0.016" to 0.032" below the minor diameter. Choose the initial diameter in such a way that the major diameter of the thread is not being rolled.

Thread length:

The thread rolls are exposed to higher stresses when the thread is being started, especially where the initial pressing speed disagrees with the required feed rate. Therefore, lower figures expressed in feet of threads produced must be expected for short threads as compared with long threaded parts. The decisive factor for evaluating the life of thread rolls in terms of feet of threads produced will always be the economy of the process rather than a comparison with the results obtained with other threads and materials. If, for instance, 100,000 or 200,000 threaded parts per set of rolling dies are produced on an automatic screw machine, the result may be a more 1,000 threads or so when rolling threads into high-strength material having a strength of 95 long tons per square inch. Still, the thread rolling method may yet be the cheapest as the cost for producing the thread by any other method may be a multiple of the rolling cost.

6. Consequences of improper setting and use of the RR 22-2

Equipment and setting errors	Effects
Failure to observe order of 1, 2, 3 when installing the profile rolls in the rolling head.	The part produced has more than the required number of threads, for instance two instead of one. For correct installation see paragraphs 2 and 3 on pages 7 to 13.
The angle of the roll holders installed in the head differs from the angle specified in the roll holder table for the thread in question.	This affects the pitch of the thread being rolled. Reeling errors in the screw thread are also possible, a thread of reduced quality is obtained. Higher stressing of the profile rolls. Number of threads affected when rolling fine threads. For correct holder selection see roll holder table.
Roll holders or profile rolls with different set numbers installed in the head.	Due to unavoidable manufacturing tolerances between individual runs, it is not always possible to obtain threads of the quality that can be expected from threads produced with a set of tools from one production run.
Wrong number or defective needles used in the profile roll bearings. (Needles having a brownish tint become unsuitable for use.)	Destruction of needles, seizing of profile roll and breakdown of rolls. When installing profile rolls make sure to use complete number of needles in complete sets. See paragraph 3, page 10.
The profile roll pins are heavily worn.	a) Due to the action of the bearing needles, the surface of the profile roll pins on the pressure side becomes pitted and is thus destroyed in the course of time. b) Not to be confused with bare pressure marks. c) Replace the roll pin as soon as these, initially scattered, pits have formed into a

	continuous destroyed area on the pressure surface to avoid the risk of needle and roll breakdown.
Rolling head fails to open fully.	Profile rolls cause marks on the major diameter of the thread when the part is withdrawn. Cause: heavily contaminated rolling head - clean! Weak springs [36] for opening the head may be another cause.
The coolant is contaminated by chips or abrasive particles.	Coarse or flaky thread flanks. Bulky chips may be caught between the part and the rolls and thus destroy the rolls. Operating trouble due to contamination of the head is another risk. - Remedy: Filter in coolant line and protection of rolling head station from chips.
The rolling head is not sufficiently concentric with the part.	The thread may be fully rolled on one side only, the part may be bent (with long rods) or the thread may become tapered (in the case of short threads). If there is a wide discrepancy profile roll destruction is likely.
Parts of greatly varying diameter (rolled stock) or crooked parts.	The threads are not perfectly rolled, the threaded parts are not straight. Risk of profile roll destruction due to heavy overrolling in certain places. Thread rolling tools are not straightening tools.
Failure to observe instructions regarding diameter of thread, paragraph 4, and determination of initial diameter of part, paragraphs 5.1 (page 14) and 5.1.2 (page 16).	Threads that are not fully rolled or are overrolled and thus cause the destruclion of the profile rolls.
The chamfer at the front end of the part has not been correctly chosen.	Poor quality of initial portion of thread, the first turns being shorn off. Excessive chamfer angles result in too much

	engagement pressure and thus in added profile roll wear. Chamfer angle for vee-threads 15°, chamfer angle for Acme threads 8° to 10°, beginning 0.016 to 0.032" below the minor diameter. If the chamfer is not concentric with the part, the thread will not be concentric either and short threads may thereby become tapered. See paragraph 5.1.3 on page 18.
The feed motion for starting the thread fails to agree with the thread pitch per revolution when rolling.	Poor quality of initial portion of thread. If feed pressure is applied too slowly, the threads of the profile rolls fail to enter the required pitch but press into the chamfer only so that the material becomes inadmissibly hardened and presents a risk of destruction of the profile roll contour. Excessive feed pressure causes excessive stresses on the roll profile which thus becomes exposed to destruction. The thread is started in accordance with the pitch if only one thread start is to be seen instead of a confusion of starts which only unite in one thread after the second turn.
Feed motion during the thread rolling operation fails to agree with the thread pitch.	A feed motion imposed during the rolling operation and which is at variance with the thread pitch produced by the rolling dies is liable to deform the pitch and exerts undesirable forces on the rolling dies. The feed motion should therefore be stopped after the first two or three thread turns so that the part is pulled through the rolling dies with a minimum of resistance. A compensating shank made by this company can be of help in special cases.

	Your enquiry is welcomed.
Insufficient pressure for clamping the part.	When the thread is started, the part pressed into the clamping device, turns with the rolling head or is pulled out of the clamping device when the feed movement is stopped so that the head fails to open. The thread is not rolled to the required length. An added risk of roll breakdown is also involved.
Insufficient rolling speed.	At rolling speeds of less than 100 fpm the roll life in terms of parts produced is noticeably reduced. See rolling speed information in paragraph 5.2.1, page 19.
Over-Rolling a thread several times or re-Rolling a cut thread.	This involves a risk of profile roll breakdown, especially where a previously rolled thread is overrolled a second time as the first rolling operation has caused a hardening of the material.

6.1. Imperfect threads

Defects of the rolled threads	**Causes and remedies**
The major diameter of the thread is not uniformly rolled or is partly over-Rolled.	Check for a uniform initial diameter and for concentric mounting of the rolling head with respect to the part. A lack of uniformity or homogeneity may be another cause, such as rolled or forged stock with decarbonized exterior layers.
Irregular effective diameter.	The initial diameter has not been uniformly maintained.
Thread is incomplete and is not fully rolled.	Check to see that the head clicks shut when closing (dirt) or that - in the case of

	revolving rolling heads - the closing device moves the head sufficiently far into the engagement of the locking plates. Also make sure to see that the grub screws [301] and the head cap screws [305] in the scroll are absolutely tight.
Poor initial portion of thread.	Correct the feed rate or the chamfer angle.
Thread has two starts instead of one.	Check the profile rolls for correct sequence. If this is correct, reduce the pressure when starting the thread. Important in the case of fine threads.
Thread becomes slightly tapered when rolling short threads.	Part has bore or centering hole. If the wall is too weak, the thread is compressed to a greater extent. Remedy: drill the hole after the thread rolling operation. The opening of the rolling head may also be impaired: clean the rolling head and see that all parts are freely movable. Finally, check that the chamfer angle is correct. An error here can cause too much material displacement from the front end of the thread in the direction of its axis.
The threaded parts become crooked.	Rolling head part are not sufficiently con-centric or the chamfer is not sufficiently con-centric. With pipes: internal and external dia-meter are not concentric. The material has inherent stresses and no uniform structure. Annealing may relieve the strains. In the case of rolled stock: irregular initial diameters can result in over-rolling of the major diameter in certain areas. Too much distance between the clamping point and the engagement of

	the rolling dies. Insufficient rolling speeds can also cause bending of long threaded parts.
Unsatisfactory thread pitch.	Irregular thread pitch. 1. Check for easy movement of feed carriage under load (rolling torque). 2. Check part for uniformly rolled thread and the absence of only partly rolled areas. 3. The trouble may be due to a lack of uni-formmity and homogeneity in the material. Uniform deviation of thread pitch towards plus or minus: If the thread is perfectly rolled, the cause may reside in the material. 1. Minor corrections are possible by using roll holders with the next larger or next smaller pitch angle. 2. Major corrections are only possible with special rolls with specially corrected pitch. 3. With some materials, minor pitch correc-tions are also possible by using a wider or closer adjustment of the head, the diametral tolerances of the thread permitting.
Thread flanks scale or are marked by a coarse or spotted surface; destruction of threads by the rolling operation.	The material is too brittle and thus unsuitable for thread rolling. Previous cold work may have caused inadmissible surface hardening (cold drawn materials). High sulphur or lead components as favoring the removal of short chips with free-cutting steel also have an adverse effect on the surface finish of rolled threads. Moreover, chips and abrasive

	particles in the coolant are liable to damage the surface finish; such detriment may also be caused by residues of lubricants on the surface of cold drawn materials. Excessively coarse pre-machined work surfaces are also likely to affect the rolled thread surface.
Thread roll profile breaking off.	Heavy rolling over the thread major diameter, i, e. rolling with too much pressure - see paragraph 4 for adjustment of rolling head and paragraphs 5.1.2 on how to determine the initial diameter. Hard or eccentric engagement of the part with the rolls. Chips in the coolant breaking down the rolls or causing an excessive pressure between the profile rolls and the part.

7. Method of operation for rotating rolling heads type RR 22

The thread rolling head incorporates three equi-spaced idling profile rolls and produces external threads in one pass by cold work. The rotating thread rolling head screws itself onto the part in axial direction in accordance with the helix angle. The feed motion to be provided by the machine is only required for starting the thread during the first two to three turns of the thread. After this, the feed rate should adjust itself without forced feed as a function of the speed, thread pitch, and the cold work characteristics of the material.

The rolling head is automatically opened by stopping the feed movement after the thread has been rolled to the desired length; the head can also be opened by moving the closing ring as required. In both cases, the rolling dies inside the rolling head are automatically unlocked, and the profile rolls are moved out of engagement by the rolling force.

Opening of the head by stopping the feed movement:

a) By movement of the part against an internal stop incorporated in the bore of the main spindle. This assures threads of equal length at any time.

b) By external limitation of the feed movement – movement of the feed carriage against a stop or throwing into reverse. This method ensures identical position of the thread runout with respect to the position of the part in the vise.

Closing of the rolling head by movement of the closing ring:

The opening and closing operations are performed at full operating speed. Thanks to the automatic opening of the thread rolling head, no separate tripping mechanism is required at the machine. For closing the head, a carrier or driving device is required for the closing ring; in the reverse direction, this device can also be used for opening the head.

The thread rolling tools, roll holders and profile rolls, within the working range of the head are easily changed and are to be combined as required by the diameter, meter, thread pitch, and thread profile. See the roll holder table on page 43.

8. Operation and use of the thread rolling head

8.1. Operation

The three roll holders [201] with the thread profile rolls [204] are swivel-mounted inside the body [10]. They are backed by the cams of the scroll [300]. For the adjustment of the thread diameter, the scroll has a twisting motion on the guide collar [30] and is clamped on the guide collar by means of the head cap screws [305] and the insets [303]/ [304]. The rotary movement is effected by means of the grub screws. [301]. For opening and closing the head, the guide collar and scroll together are pivotally mounted on the body; stop plates [37] and lock plates [69] hold them in place on the intermediate ring [60] and prevent any twisting movement.

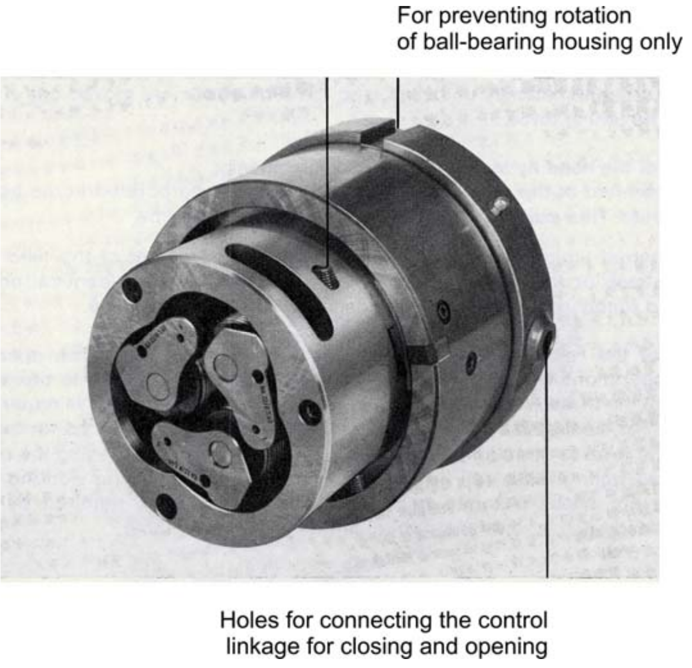


Fig. 10: Thread Rolling Head RR 22-2

By stopping the feed movement during the thread rolling operation, the thread profile rolls continue to screw themselves upon the part, pulling the body with guide collar and scroll from the lock plates [69] at the intermediate ring in axial direction. The guide block [63] keeps preventing any twisting movement of the body, while the compressing springs [36] and the roll holder pressure (compression springs [15] and rolling pressure) twist the scroll with guide collar so on the body that the roll holders slip off the cams and open.

For closing the rolling head, axial movement of the closing ring [80] over the closing plates [44] causes the scroll and guide collar to be twisted until the stop plates [37] engage in the lock plates [69] at the intermediate ring. The non-revolving carrier mechanism of the machine for the axial movement of the closing ring is engaged in the two holes of the ball-bearing housing [85] above the closing ring. For engagement of the stop or lock plates, the body with scroll and guide collar are pressed against the intermediate ring by means of the compression springs [73] and the cylindrical head screws [71]. The body is held on the intermediate ring by means of the head cap screws [71] for a length equal to the head extension stroke.

Following the closing operation, the closing ring must be returned to operating position by the amount of twisting movement. In this position, when the rolling head is opened, the scroll and guide collar are allowed to turn freely without the closing cams of the guide collar hitting the closing cams of the closing ring.

If the closing ring is pushed on the body and guide collar are forced out of the lock plates [69] and the rolling head is opened.

8.2. Use

8.2.1. Adjusting the rolling head

The following operations have to be performed on the rolling head:

1. Installing or changing the roll holders and profile rolls.
2. Adjusting the thread diameter.

The following controls are operated while working with the rolling head:

1. Axial movement of the closing ring for closing the rolling head and feed movement to operating position.
2. Only where the rolling head is to be opened by means of the closing ring: axial movement of the closing ring from operating position to opening position.

8.2.2. Adjusting the thread length

The rotating thread rolling head contains no facilities for adjusting the thread length. These facilities must be provided at the machine.

Note

Length adjustment by means of internal stop incorporated in the central bore of the main spindle:

This assures threads of equal length at any time, regardless of the position of the part in the workholder.

Length adjustment by external feed limitation:

Movement of the feed slide against a stop or switching to return movement. -

This assures identical position of the thread runout with respect to the position of the part in the workholder. Threads of identical length are only obtained if the parts are always clamped in the same position.

8.2.3. Dismantling and assembling the rolling head

The rolling head should be taken apart from time to time to clean out the abrasive particles resulting from the rolling operation and thus ensure dependable operation of the rolling head. After cleaning, treat the sliding surfaces inside the rolling head liberally with molybdenum di-sulphide.

Dismantling the rolling head

The removal of the scroll and of the roll holders has been described in paragraph 2.

Proceed with removing the head cap screws 9 with the compression springs [73] for the telescopic head stroke. Pull the body plus the complete guide collar from the intermediate ring and out of the closing ring. To do this, twist the guide collar a little in anticlockwise direction until the body is disengaged from the guide block [63]. The closing cams of the guide collar must pass through the respective indentations in the closing ring adjacent to the closing plates. For these operations, the closing ring must be pulled to its front position.

Loosen the head cap screws [500] and pull the intermediate ring from the spindle; the closing ring can now be pulled from the intermediate ring towards the back.

For removing the guide collar from the body, withdrawn out the head cap screws [34] from the closing segments [32] in the guide collar. Twist the guide collar on the body as required to permit the four head screws [13] for the two clamping segments to be withdrawn out trough the holes for the screws [34] in the guide collar. The two compression springs [36] push the two clamping segments out of the groove in the body and against the guide collar; if binding, turn the screws [34] into the tapped hole in the clamping segment [11] and lift by introducing a screwdriver through the hole in the guide collar. The guide collar is now easily pulled from the body. All parts are now accessible for cleaning, and the stop and lock plates [37] and [69] can be replaced, if necessary.

Assembling the rolling head and mounting it to the spindle

First of all, slide the complete closing ring [80] with two closing plates [44], two keys [45], including ball bearing [90] and ball bearing housing [85] with parts [89], [93], [88], [91]) on the completely assembled intermediate ring (two lock plates [69], one guide block [63], one lock pin [77], two sliding keys [61]) and secure the intermediate ring to the main spindle by means of the head cap screws [500].

Proceed with inserting the two clamping segments [11] and the two closing segments [32] with the two compression springs [36] into the groove in the hole of the guide collar, observing the position and order shown in the sectional view of the rolling head.

Working in clockwise direction insert one closing segment [32], one clamping segment [11], one compression spring [36] in such a way that the pin in the clamping segment is inside the compression spring and the bevelled side of the clamping segment faces the closing segment.

See that the retaining ring [18] and hook type spring ring [20] are installed in the body of the head; the thrust bushings [16] with the compression springs [15] must also be installed.

Slip the guide collar over the body in such manner that the clamping segments can be pressed into the annular groove in the body. Twist the guide collar until the two clamping segments [11] can be secured in the body by means of the four head cap screws [13] through the holes for the screws for the closing segments. Keep twisting the guide collar until the two closing segments [32] can be secured to the guide collar by means of the screws [34] and the two closing plates [44] can be secured by means of screws.

See that the stop plates [37] and lock plates [69] are secured in the guide collar. Slide the body with the completely assembled guide collar into the closing ring and onto the stem of the intermediate ring. Guide the closing cams of the guide collar along the respective surfaces of the closing cams at the closing ring. Twist the body if a resistance is felt. Introduce dowels into the holder bores for easy twisting, using wood or a similar material to prevent damage to the holder holes.

Keep turning the body until its groove engages in the guide block [63] on the intermediate ring. Then, slide against the intermediate ring and tighten by means of the head cap screws [71] with the compression springs [73] which are to be inserted through the holder bores.

By sliding back the ball bearing housing 18 (closing of the head) and sliding the housing forward again (opening of the head) check for correct engagement in locking position and entirely free movement of the guide collar on the body after disengagement from locking position.
For details on the scroll and the insertion of the roll holders see paragraph 2.

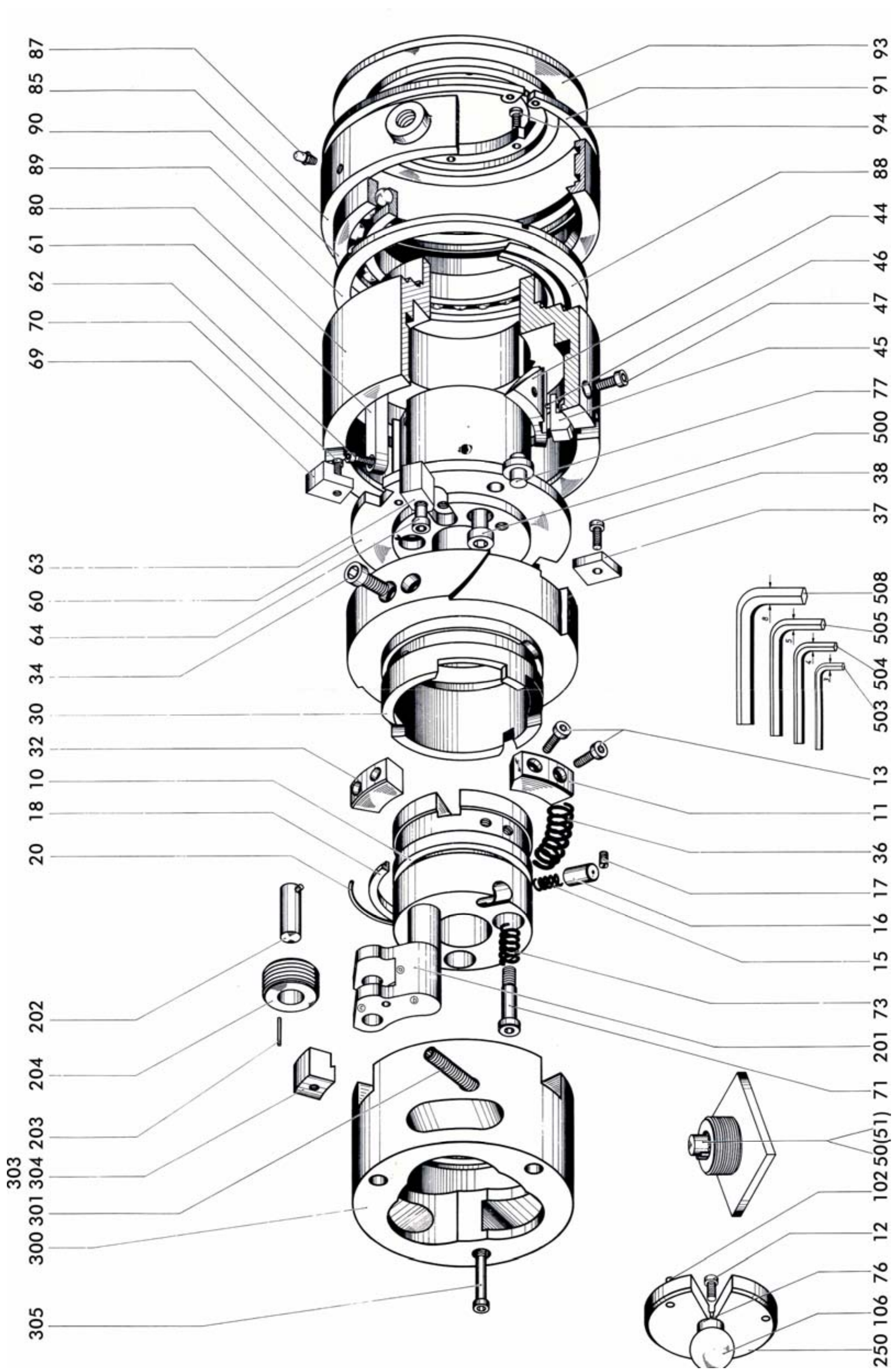
9. Spare parts list Rotating Rolling Head, type RR 22-2

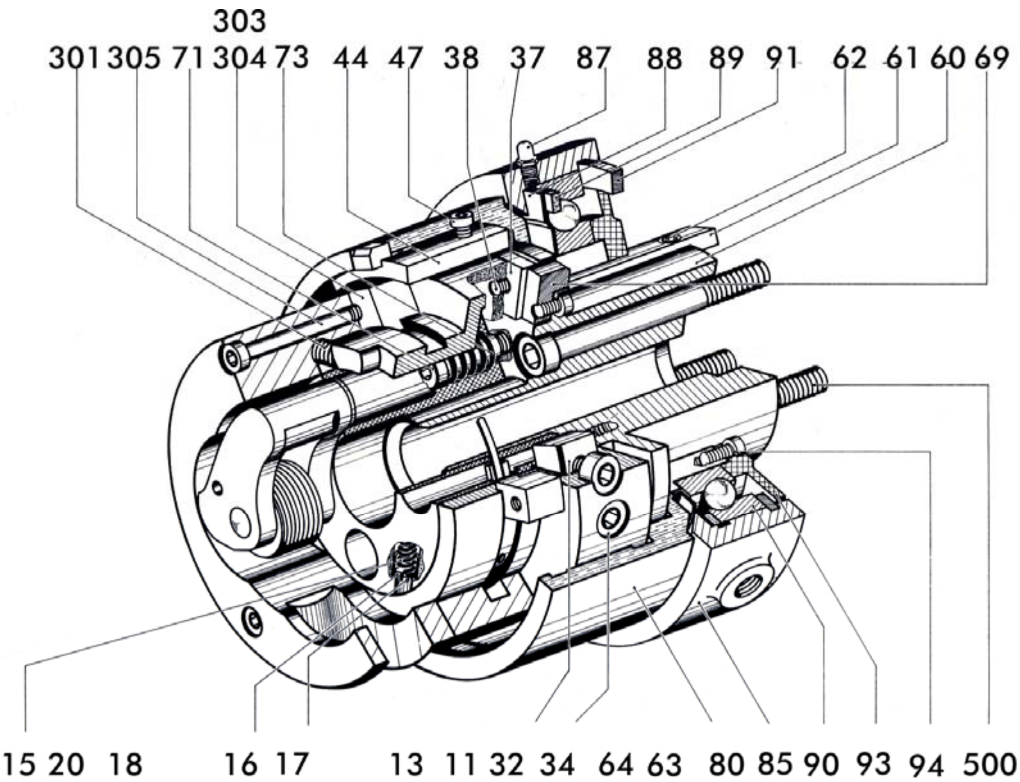
Product number: 75713400

ID No.	Quantity	Designation	Article No.
100	1	HEAD BODY	72675200
110	2	CLAMPING SEGMENT	70205500
130	4	CYLINDER HEAD SCREW M5X20	02016055
150	3	COMPRESSION SPRING	03310107
160	3	THRUST BUSHING	70205900
170	3	SHANK SCREW M4X8	02030055
180	2	RETAINING RING	70206000
200	1	SPRING RING	02175025
300	1	GUID COLLAR	73153400
320	2	CLOSING SEGMENT	70205600
340	4	CYLINDER HEAD SCREW M8X20	02016155
360	2	COMPRESSION SPRING	03310250
370	2	STOP PLATE	72675700
380	2	CYLINDER HEAD SCREW M5X8	02016051
440	2	CLOSING PLATE	70207500
450	2	KEY FEATHER	70525700
460	2	DOWEL PIN	02116153
470	4	CYLINDER HEAD SCREW M6X10	02016103
600	1	INTERMEDIATE RING (COMPLETE)	78039900
610	2	SLIDING KEY	73153300
620	4	CYLINDER HEAD SCREW M6X16	02016104
630	1	GUIDE BLOCK	71604900
640	1	CYLINDER HEAD SCREW M8X50	02015174
710	3	EXTENSION SCREW M8X40	70206300
730	3	COMPRESSION SPRING	03310126
770	1	LOCK PIN	70208600
800	1	CLOSING RING	70207100

850	1	BALL-BEARING HOUSING	70207200
870	1	BALL LUBRICATOR	02882001
871	2	GRUB SCREW M6X6	02045153
880	1	SEALING RING	03526118
890	1	SPACER RING	70207300
900	1	BALL BEARING	02401019
910	1	CIRCLIP	02085065
930	1	COVER	70207400
940	6	CYLINDER HEAD SCREW M5X12	02016053
2500	1	CLAMPING DISK (COMPLETE)	78003300
3000	1	CAM RING	72675400
3010	2	GRUB SCREW M8X40	02045212
3030	3	INSET	72675600
3040	3	SPRING	03310043
3050	3	CYLINDER HEAD SCREW M6X60	02015116
5000	3	CYLINDER HEAD SCREW M10X80	02016216
5030	1	SCREW DRIVER 3 DIN 911	02677003
5040	1	SCREW DRIVER 4 DIN 911	02677004
5050	1	SCREW DRIVER 5 DIN 911	02677005
5080	1	SCREW DRIVER 8 DIN 911	02677008

Rotating Rolling Head RR 22-2

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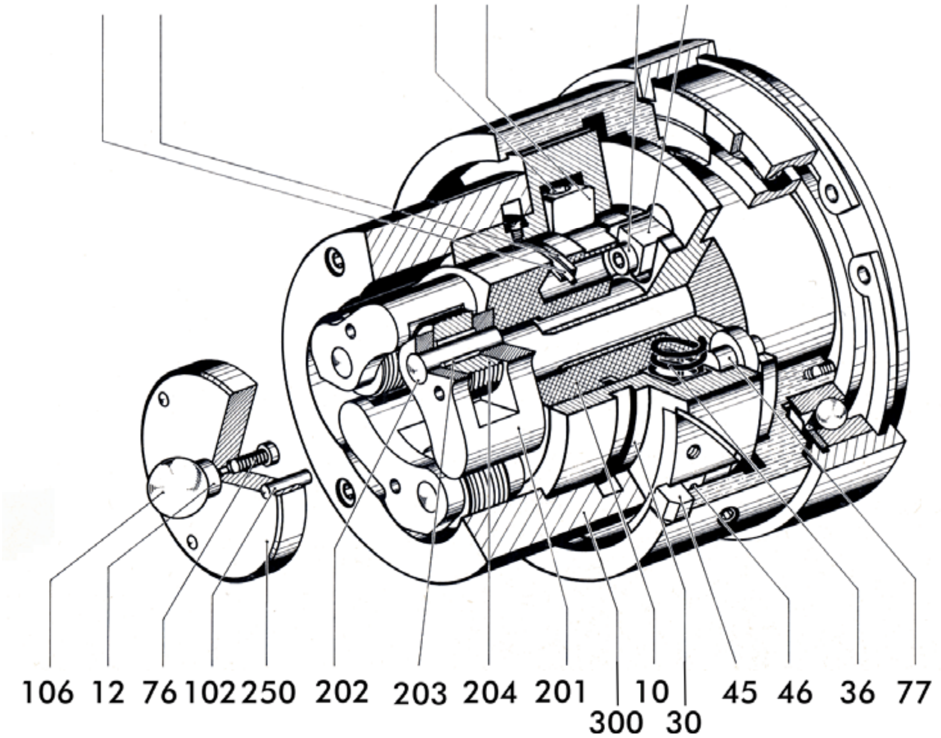
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300 30

10. Roll Holder Table RA 22

Roll holder Designation Prod.-No. Max. shoulder dia.	Rolls Designation	Rolling range Core dia. in mm from ... to Max. out-dia.	Thread types Metric thread DIN 13	Metric fine thread DIN 13	Whitworth- thread DIN 11	BSF thread	Whitworth- pipe thread DIN 259, 2999	American threads UNC	UNF	UNEF	UN	UNS	NPT
RA22-0-3,8 757442 KD + 8,4	**R25**	3,8 ... 12,4 15,0	M5* M6 M7	M4,5 - 6,5x0,5 M5,5 - 6,5x0,75	1/4 5/16 - 1/2	1/4x1/26 5/16x1/22		Nr. 12-24 1/4-20 5/16-18 3/8-16 7/16-14 1/2-13	Nr. 12-28 1/4-28	Nr. 12-32 1/4-32	5/16-20	Nr. 10-36 ... 48 Nr. 12-36 ... 48 1/4-24 ... 48 1/2-12	
RA22-1-3,0 757444 KD + 16,4			M8 - 18	M7,5 - M9,5x1 M10 - 12x1,25 M12 - 14x1,5 M18x2	3/8 - 1/2	3/8x1/20 7/16x1/18 1/2 - 9/16x1/16 5/8 - 11/16x1/14		9/16-12 5/8-11	5/16-24 3/8-24 7/16-20 1/2-20		5/16-28 3/8-20 7/16 ... 9/16-16 5/8-12	5/16-27 3/8 ... 7/16-18 1/2-14 ... 18 9/16 ... 5/8-14	1/16-27
RA22-1-2,0 757446 KD + 16,4		6,0 ... 15,0 18,0		M7 - 9x0,5 M7 - 15x0,75 M9,5 - 16x1 M15 - 17x1,5			R1/8 - 3/8		1/2-20 9/16-18 5/8-18	5/16 ... 3/8-32 7/16 ... 1/2-28 9/16 ... 5/8-24	3/8-28 1/2-32 9/16-20 ... 32 5/8-16 ... 20	5/16-36 ... 48 3/8-27 ... 40 0,390-27 7/16-24 ... 27 1/2-24 ... 27 9/16 ... 5/8-27	1/8-27 1/4-18 3/8-18
RA22-1-1,0 757448 KD + 16,4	**R27**			M9 - 15,5x0,5 M12 - 16x0,75 M16x1							5/8-28 5/8-32		
RA22-2-3,2 757450 KD + 16,4			M18 - 22	M24x2,5		3/4 - 13/16x1/12 7/8 - 15/16x1/11 1x1/10		3/4-10			11/16-12 3/4-12 13/16-12	7/8-10 1-10 ... 14	
RA22-2-2,0 757452 KD + 16,4		14,0 ... 23,0 26,0		M18 - 25x1,5 M20 - 25x2			R1/2		3/4-16 7/8-14 1-12	5/8-24 11/16-24 3/4-20 13/16-20 7/8-20	7/8-12 11/16-16 ... 20 13/16-16 7/8-16 15/16-12 ... 16	3/4-14 ... 24 7/8-18 1-10 ... 14	1/2-14 3/4-14
RA22-2-1,0 757454 KD + 16,4				M15 - 23,5x0,5 M16 - 24x0,75 M16 - 24x1 M23 - 25x1,5						5/16.-20	11/16-28 ... 32 3/4-28 ... 32 13/16-28 ... 32 7/8-28 ... 32 15/16-28 ... 32	3/4-27 7/8-24 7/8-27	
RA22-2-3,6 757456 KD + 16,4	**R27/22**		M24		3/4 - 1			7/8-9 1-8					
RA22-3-2,0 757458 KD + 16,4	**R27**	21,0 ... 31,2 34,0		M26 - 34x2			R3/4 R7/8 - 1 nur DIN 259		1-12 1.1/8-12 1.1/4-12		15/16-12 ... 16 1-16 1.1/16-12 ... 16 1.1/8-16 1.3/16-12 ... 16 1.5/16-12 ... 16 1.1/4-16	1-18 1.1/8-10 ... 14 1.1/4-10 ... 14	
RA22-3-1,0 757460 KD + 16,4 KD + 1,64				M23 - 32x0,75 M23 - 32x1 M24 - 33x1,5 M30 - 34x2						15/16-20 1-20 1.1/16 ... 1.5/16-18	15/16-28 ... 32 1-28 ... 32 1.1/16 ... 1.5/16 -20 ... 28	1-24 ... 27 1.1/8-24 1.1/4-24	
KD + 13,4	**R26**	24,0 ... 34,2 37,0		M33 - 35x0,75 M33 - 35x1 M34 - 36x1,5 M35 - 36x2					1.3/8-12	1.5/16-18 1.3/8-18	1.5/16-20 ... 28 1.3/8-14 ... 28 1.7/16-12	1.3/8-10 ... 24	

KD = Core diameter
* R25 with outside dia. 24.5

Max. thread length including runout
For threads more than dia. 27 to 32 = 50 mm
more than dia. 32 to 35 = 26 mm

Roll OD/bore x width	Pcs. needles dia. x length	Product-No.	Roll bolt dia. x length	Product-No.	Carbide bushes OD/bore x width	Product-No.
R25=25/15x13	45-2,5x12,8	03462061	10x33	745453	15/10x12,9	03463102
R26=32/17x17 R27=35/17x17	54-2,5x16,8	03462065	12x33	702392	17/12x16,8	03463103
R27/22=35/17x22	54-2,5x21,8	03462067	12x35	724113	-	-